Interannual changes in the carbon budget of European forests: detecting hot-spots periods of variability.

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(1) The interannual variability of carbon fluxes of forest ecosystems is analysed at both site and regional level by locating the seasonal period which explain the annual fluxes variability (hot-spot periods, HSP), and finding their meteorological driving causes.

(2) The analysis is first conducted on seven European forest sites representing contrasted species and climatic conditions. Net Ecosystem Exchange (NEE), separated into Gross Primary Production (GPP) and ecosystem respiration (TER), together with ancillary data measured during several years provide useful information about meteorological and physiological controls of ecosystem carbon fluxes variability. HSP and their climatic causes were found on these sites. The ability of the ORCHIDEE process-based model to represent the HSP and their climate drivers is assessed at this scale by comparing the measurements with the simulations.

(3) Secondly, up-scaling to European forests was performed with ORCHIDEE simulations at a 0.25° grid. Maps of HSP for GPP, TER and NEE, and their meteorological drivers were analysed. The GPP interannual variability is explained by spring and summer month periods, whereas HSP_{TER} occurred throughout the year. As a result of compensating effects between GPP and TER, the periods of HSP_{NEE} are reduced compared to HSP_{GPP} and HSP_{TER}. It is shown that there is a latitudinal contrasted pattern of HSP for GPP and TER, positively controlled by temperature in northern Europe, and by soil water availability in southern Europe. This latitudinal boundary fluctuates from early spring to late summer for the HSP_{GPP}, whereas it is less clear for HSP_{TER}. HSP_{NEE} and their meteorological drivers mainly follow the GPP ones.